tion, the sphygmograph, or pulse-marker, of Marey is the most noteworthy. This instrument not only indicates, but registers on a card, "the form of the pulse," and thus shows many varieties of it which the touch fails to recognize. The essential part of the instrument is a lever, the end of the short arm of which is pressed upon the artery, and that of the other, which carries a point, presses against a card that is made to slide steadily past it. As the artery fills and empties, the lever rises and falls, and thus traces its movements. The result of experiments with this instrument, and of Marey's other experiments in the passage of fluids through elastic tubes imitating the vascular system, are among the most valuable of the recent contributions to the physiology of the circulation of the blood.

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16. — *Mind in Nature; or the Origin of Life, and the Mode of Development of Animals.* By HENRY JAMES CLARK, A. B., B. S. With over Two Hundred Illustrations. New York: D. Appleton & Co. 1865. 8vo. pp. 322.

THIS work comprises the substance of a course of lectures delivered before the Lowell Institute in 1864, and relates chiefly to three subjects, — the origin of life, the great divisions of the animal kingdom, and the conformity of animals in their mode of development to the type of the divisions to which each animal belongs.

In admitting five grand divisions instead of four, Professor Clark follows the lead of many naturalists who have found it otherwise impossible to dispose of a portion of the Infusoria. Cuvier left these a heterogeneous mass among the Radiates. Ehrenberg threw a flood of light on their structure, and but little on their zoölogical relations. Many of them have since been shown to be plants, others embryos, and still others have been referred to one or the other of the types of Invertebrates. Agassiz believes that all will in this way be eventually distributed. But as it now stands, a portion still remain which cannot be referred to either of the categories just mentioned, and are therefore regarded as forming the grand division to which the term Protozoa has been applied, and of which Professor Clark finds a characteristic feature in the spiral type of structure. Before this can be admitted as anything more than a provisional arrangement, these organisms require a much more complete investigation than they have yet received, and we know of no one better prepared for the work than Professor Clark himself. The chapter on the third head mentioned above agrees in principle with views already adopted by others; and

its chief value comes of the original observations by the author which it contains.

The most attractive as well as instructive part of the work is that relating to the study of the lowest organisms. It is from these that, of late years, physiologists have learned much, and from them they have yet much more to learn. Studying almost exclusively the higher animals, they see organs under their most complex arrangements, and in the attempt to explain their uses find themselves misled at almost every step by the labyrinth into which they enter. In these lowest organisms we have living beings stripped of all accessory parts, and retaining only what is necessary for the manifestation of life; we have living beings reduced, as it were, to a definition. The observations of Ehrenberg led to the belief that the Infusoria, too, are far from being the simple organisms they were supposed. With better microscopes than his, however, naturalists have shown that there is still a portion in which no organs whatever have been detected, and in the composition of which not even cells can be traced. So far is it from the truth that each function must have its appropriate organ, we have the best evidence that an organism as structureless as a mass of jelly may perform the general functions of animal and organic life, each and all in every portion of its body. Of several kinds of such we may mention the *Amœba* (the Proteus of the earlier microscopists), which breathes, absorbs, and excretes by the whole surface of the body. It has neither mouth nor digestive canal, but can extemporize either of these anywhere. As the food touches the surface, it is covered over and enclosed as a stone is by the water into which it sinks. The space surrounding the food becomes a temporary stomach, exerts a solvent action, the nutritive portion is absorbed, and the refuse is transferred to the surface, and is set free, like air from a bubble when it rises from the water and breaks. Every part of this remarkable creature is contractile, and whoever will take the trouble to watch its motions cannot fail to come to the conclusion that every part is also the seat of sensation and perception.

After his admirable studies in embryology, and with his acknowledged skill in the use of the microscope, Professor Clark is especially fitted for the investigation of these lowest organisms, and it is from this that he takes his point of departure in the present work. It is certainly most reasonable to suppose that the study of the origin of life might be carried on among these organisms with the best chance of success. But Nature veils all her processes, and is never more mysterious than when life begins. At the outset Professor Clark assumes the reality of spontaneous generation, and the argument for this is one of the chief

subjects of which he treats. In the doctrine itself, there is nothing unreasonable; but, on the contrary, when one goes back in thought to the origin of living beings, and attempts to form some conception of their first appearance on the surface of the earth, is there any valid reason for the belief that the movements of atoms and the causes of these movements in the creation of a new being would not have been as invisible or mysterious as they are now in the formation of a germ or the development of an embryo? Would not the Creator have been as unseen at the dawn of life as he is to-day? and would not man have fallen back then, as he does now, on the forces of nature, to explain the modes in which the Creator acts? Be that as it may, the question with regard to the existence of spontaneous generation now is rightly put by Professor Clark when he asks "whether the Creator has not continued to exercise the creative faculty at all times, even to the present day." No less an authority than Professor Owen has asserted his belief in the affirmative when he says, "What I have termed 'the derivative hypothesis of organisms,'" (and which he advocates,) "for example, holds that these are coming into being by the aggregation of organic atoms at all times and in all places under the simplest unicellular condition, ... one form appearing in mud at the bottom of the ocean, another in the pond or on the heath, a third in the saw-dust of a cellar, a fourth on the surface of a mountain rock, &c., but all by the combination and arrangement of organic atoms through forces and conditions acting according to predetermined law."

The proof of this "coming into being" is, however, just what observation and experiment have hitherto failed to give. If spontaneous generation exists anywhere, it is most likely to be found among the lowest organisms; in fact, all others are eliminated from the question. What, then, is the nature of the evidence on which the doctrine at present rests? It is on the fact that a given solution of organic matter, exposed only to air that has passed through a red hot-tube, or that a similar solution enclosed in an hermetically sealed vessel and subsequently immersed in boiling water for two or three hours, has been known to become the seat of infusorial life. The various experiments which have been tried, including those cited by the author in detail, prove this and nothing more. If all the life in the flasks was really destroyed at the beginning of the experiment, then the appearance of the living organisms can be accounted for only by the theory in question. One might reasonably suppose that boiling water would be destructive of life. But in view of the instances where Infusoria have been observed living in a medium of high temperature, and of the fact that certain *Algæ* live and flourish in thermal springs, the heat

of which approaches nearly to that of boiling water, it is certainly justifiable to entertain the belief that the vital resistance would still be maintained, even if the solution was heated to the temperature used in the experiments. There is without doubt a point at which resistance is at an end, but this has not yet been determined. As to the instances in which it is alleged that life was destroyed when dealing with such minute structures as *Vibrios* and *Bacteriums*, assent may well be withheld from the statement until the maker of the experiments tells us what were the signs which led him to his conclusions, —what were the indications that life was really extinct. The whole subject is one of deep interest, and is worthy of far more attention from those accustomed to make careful experiments than it has yet received.

The views advanced by Professor Clark, that individual life does not begin with the mature egg, but that the egg itself in all its phases is the individual, are different from those usually held, but are maintained by Agassiz. From the study of the higher animals, where fertilization is necessary, one would be disposed to reject this view, and consider the individual as beginning after the process just mentioned. But since among some of the lower animals, as the Aphis, where fertilization for a series of generations is not necessary, all the phases of development, from the nucleated cell to the perfect individual, are passed through without interruption, the only starting-point for individual life is that at which the cell begins to take an independent action, long before it assumes the form of an egg in the sense in which this last is commonly understood.

The chapter on reproduction by budding contains many additions to science, of great value, derived from the author's original observations on various kinds of Infusoria, sea-anemones, jelly-fishes, &c., but we think he has pushed matters too far in considering double monsters as instances of this mode of reproduction. In so far as they have been observed in their formative stage, the primitive germ of such monsters is double at the outset, each of the doubled portions being developed *pari passu* the one with the other, as is seen in the instance cited and figured from Lereboullet, where the two heads and the portions of the body supporting them are equal, and give no more or less indications than other instances hitherto observed of the budding process.

We have touched upon only a few of the subjects treated of in the work which we have been noticing, and perhaps have done the author some injustice in taking merely those which are open to criticism. In conclusion, we will say that, wherever he has confined himself to observation, the results which Professor Clark has obtained are among the most important additions to embryology and zoölogy recently made.